Shri Vile Parle Kelavani Mandal's

Dwarkadas J. Sanghvi College of Engineering

(Autonomous College Affiliated to the University of Mumbai)

Scheme and Detailed Syllabus (DJS23)

Third Year B. Tech

in

INFORMATION TECHNOLOGY

(Semester VI)

Revision: 3 (2025)
With effect from the Academic Year: 2025-2026

1st July 2025

Shri Vile Parle Kelavani Mandal's
DWARKADAS J. SANGHVI COLLEGE OF ENGINEERING
(Autonomous College Affiliated to the University of Mumbai)
NAAC Accredited with "A" Grade (CGPA : 3.18)

Scheme for Third Year Undergraduate Program in Information Technology: Semester VI (Autonomous)
(Academic Year 2025-2026)
SEMESTER VI

Sr. No.	Course Code	Course	Teaching Scheme				Semester End Examination (A)						Continuous Assessment (B)						Aggregate (A+B)	Credits Earned	
			Theory (hrs)	Practical (hrs)	Tut (hrs)	Credits	Duration (hrs)	Theory	Oral	Pract	Oral & Pract	SEE Total (A)	Term Test 1 (TT1)	Term Test 2 (TT2)	Term Test 3 (TT3)	Term Test Total (TT1 + TT2 + TT3)	Term Work	CA Total (B)			
1	DJS23ICPC601	Software Engineering	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	**4**
	DJS23ILPC601	Software Engineering Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
2	DJS23ICPC602	Cryptography and Network Security	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	**4**
	DJS23ILPC602	Cryptography and Network Security Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
3	DJS23ICMD601	Machine Learning	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	**4**
	DJS23ILMD601	Machine Learning Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
4 & 5@	DJS23ICPE601	Image Processing and Computer Vision	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	**8**
	DJS23ILPE601	Image Processing and Computer Vision Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE602	Internet of Things	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	
	DJS23ILPE602	Internet of Things Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE603	Infrastructure Security	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	
	DJS23ILPE603	Infrastructure Security Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE604	Big Data Analytics	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	
	DJS23ILPE604	Big Data Analytics Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE605	Game Design	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	

	DJS23ILPE605	Game Design Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE606	Enterprise Governance of Information Technology	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	
	DJS23ILPE606	Enterprise Governance of Information Technology	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
	DJS23ICPE607	Cloud Computing	3	--	--	**3**	2	60	--	--	--	**60**	15	15	10	40	--	**40**	**100**	**3**	
	DJS23ILPE607	Cloud Computing Lab	--	2	--	**1**	--	--	25	--	--	**25**	--	--	--	--	25	**25**	**50**	**1**	
6	DJS23IPSCX04	Innovative Product Development IV	--	2	--	**1**	--	--	--	--	25	**25**	--	--	--	--	25	**25**	**50**	**1**	**1**
7	DJS23ICHSX10	Environmental Science	--	--	1	**1**	--	--	--	--	--	--	--	--	--	--	25	**25**	**25**	**1**	**1**
		Total	**15**	**12**	**1**	**22**	**10**	**300**	**125**	--	**25**	**450**	**75**	**75**	**50**	**200**	**175**	**375**	**825**	**22**	

@ Any 2 elective courses

Prepared by **Checked by** **Head of the Department** **Vice Principal** **Principal**

Continuous Assessment (A):

Course	Assessment Tools	Marks	Time (mins)
Theory	a. Term Test 1 (based on 40 % syllabus)	15	45
	b. Term Test 2 (on next 40 % syllabus)	15	45
	c. Assignment / course project / group discussion / presentation / quiz/ any other.	10	--
	Total marks (a + b + c)	40	--
Audit course	Performance in the assignments / quiz / power point presentation /poster presentation / group project / any other tool.	--	As applicable
Laboratory	Performance in the laboratory and documentation.	25	
Tutorial	Performance in each tutorial & / assignment.	25	
Laboratory &Tutorial	Performance in the laboratory and tutorial.	50	

The final certification and acceptance of term work will be subject to satisfactory performance upon fulfilling minimum passing criteria in the term work / completion of audit course.

Semester End Assessment (B):

Course	Assessment Tools	Marks	Time(hrs.)
Theory / * Computer based	Written paper based on the entire syllabus.	60	2
	* Computer based assessment in the college premises.		
Oral	Questions based on the entire syllabus.	25	As applicable
Practical	Performance of the practical assigned during the examination and the output / results obtained.	25	2
Oral & Practical	Project based courses - Performance of the practical assigned during the examination and the output / results obtained. Based on the practical performed during the examination and on the entire syllabus.	As per the scheme	2

Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Software Engineering (DJS23ICPC601)
Course: Software Engineering Laboratory (DJS23ILPC601)

Pre-requisite: Object Oriented Design concepts

Course Objectives: The objective of this course is to make students understand the essential phases and critical aspects of an overall software development process to design a high-quality software solution in a cost-effective manner for a real-world problem.

Course Outcomes: On successful completion of this course, students should be able to:

1. Select suitable software development lifecycle model(s) based on project requirements.
2. Analyze real world problems using software engineering principles.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Software Process:** Software, Software Characteristics, Introduction to Software Engineering process, Process framework, Software Process Models – Sequential, Incremental and Evolutionary Process Models. **Agile Development Process:** Concept of Agility, Agile Process Models - Extreme programming-XP, SCRUM, Feature Driven Development, LEAN, KANBAN, ASD, DSD	06
2	**Requirements Engineering (Analysis & Specification):** Software Requirements – Functional and Non-Functional requirements, Requirement Engineering Process: Feasibility Studies, Requirement elicitation and analysis, requirements validation, requirements management, Software Requirements Specification SRS.	06
3	**System Design:** Introduction to structured analysis and structured design, Data Dictionary, Data Flow Diagram, Petri Nets, Design Concepts and Principles: Modularity, Abstraction, Cohesion, Coupling Architectural Design: Layered, Client-Server, Micro services, Secure System Design Principles - Issues Relevant to Secure System Design, Design Risk Assessment Process.	09
4	**System Dependability: Dependability Properties** - Principal dependability attributes, Relationship between dependability and cost, **Sociotechnical System:** characteristics and stack, **Redundancy**: hardware, software, and information-level. **Diversity**: design, implementation, and operational diversity, **Dependable Processes -** Attributes of dependable processes, **Formal Methods and Dependability -** Classes of error in software representations: Specification, Design, Implementation, Operational, Advantages and limitations of formal specification **Security and Dependability Fundamentals -** Terminologies and Examples, Types of Security Threats, Three Security Dimensions for Secure Systems Engineering, Levels of Security, Security Risk Assessment.	09
5	**Testing And Quality Assurance:** Software testing Fundamentals- Objectives of Testing, Strategic approach for software design, Testing Strategies, Testing Techniques (Black Box Testing & White Box Testing), Software Quality Measurement indicators, factors, criteria, SQA Plan, Software Quality Standards.	06
6	**Software Management:** Software Risk Management Practices, Software Cost Estimation Techniques: Function Point, COCOMO I & II, KUTNA, Software Configuration Management.	06

List of Laboratory Experiments:

1. Write case study of proposed system and recommend a suitable SDLC model for its development.
2. Model a Real-World Problem using SCRUM Methodology.

3. Create a Software Requirements Specification (SRS) as per IEEE format.
4. Design Data Flow Diagram (DFD) up-to level 2 & E-R Diagram for the proposed system
5. Perform Project cost estimation using appropriate FP based / COCOMO Techniques.
6. Analyse dependability metrics and simulate fault tolerance for the proposed system.
7. Design test cases for testing the system under development and prepare test plan in IEEE format. Selenium tool
8. Use Git/GitHub for version control in a software project.
9. Use JIRA or Trello for project and task tracking in teams.
10. Create a Work Breakdown Structure (WBS) based on the given project or problem scenario.

Books Recommended:

Text books:

1. Roger S Pressman, "Software Engineering: A Practitioner's Approach", 8th Edition, McGraw-Hill, 2015.
2. Rajib Mall, "Fundamentals of Software Engineering", 5th Edition, PHI Learning Private Ltd, 2018.
3. Ian Somerville, "Software Engineering", 10th Edition, Pearson Education Asia, 2016.

Reference Books:

1. Pankaj Jalot, "Software Engineering: A Precise Approach", Wiley India, 2010.
2. John M. Nicholas, "Project Management for Business and Technology", 3rd Edition, Pearson Education, 2000.
3. Bob Hughes, Mike Cotterell, Rajib Mall, "Software Project Management", 5th Edition, McGraw-Hill, 2009.

Prepared by Checked by Head of the Department Principal

Program: Information Technology **T.Y B. Tech Semester: VI**

Course: Cryptography and Network Security (DJS23ICPC602)
Course: Cryptography and Network Security Lab (DJS23ILPC602)

Pre-requisite: Knowledge of -
1. Computer Networks
2. Basic concepts of OSI Layer
3. General ease with algorithms, elementary number theory and discrete probability

Course Objectives: This course intends to provide a sound foundation in cryptography. Students are introduced to basic cryptographic techniques like encryption, hashing and message authentication, in the "private key" and "public key" settings, with a focus on mathematical definitions of security. The course will also explore the current practices & challenges in network security and use cryptographic primitives in higher-level network security protocols.

Course Outcomes: On successful completion of this course, students should be able to:
1. Design secure system using appropriate security mechanisms.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction:** Security goals-CIA, the OSI security architecture, Threats, Attacks (Active, passive) on Information and vulnerability, System Security Threats, Vulnerability assessment and penetration testing. Classical Encryption techniques (Symmetric cipher model, mono-alphabetic and poly alphabetic substitution ciphers, transposition techniques: keyed and keyless transposition ciphers), Cryptography in the age of quantum computers, introduction to quantum cryptography.	08
2	**Symmetric Block Ciphers:** Data Encryption Standard-Block cipher principles-block cipher modes of operation- Advanced Encryption Standard (AES)-Triple DES	07
3	**Public key cryptography:** Principles of public key cryptosystems-knapsack cryptosystem, The RSA algorithm, El-Gamal Algorithm, Rabin cryptosystems.	07
4	**Cryptographic Hashes, Message Digests:** Authentication requirement – Authentication function, Types of Authentications, MAC – Hash function – Security of hash function and MAC –MD5 – SHA – HMAC – CMAC, hash chain and hash tree (Merkletree)	06
5	**Authentication Protocols:** Needham Schroeder Authentication Protocol, Otway Rees, Authentication Applications, Kerberos, Key Management, challenge response protocols, Diffie Hellman Key exchange, station to station key management, Digital Certificate: X.509 (EC), PKI Digital Signature Schemes – RSA, DSS, ECC.	07
6	**Network Security:** Overview of OSI Layer attacks, Firewalls, Intrusion Detection Systems: Host Based and Network Based IDS. Network Security Model, SSL, TLS, IPSEC: AH, ESP, Secure Email: PGP and S/MIME	07

List of Laboratory Experiments:
1. Design and Implementation of a product cipher using Substitution and Transposition ciphers.
2. Analysis of Block ciphers.
3. Implementation and analysis of public key cryptography.
4. Implementation and analysis of Digital signature scheme.
5. Implementation of Diffie-Hellman Key exchange algorithm.
6. For varying message sizes, test integrity of message using MD-5, SHA-1, and analyse the performance of the two protocols. Use crypt APIs.
7. Implementation of authentication protocols.

8. Explore the GPG tool of linux to implement email security.
9. Download and install nmap. Use it with different options to scan open ports, perform OS fingerprinting, do a ping scan, tcp portscan, udp port scan, etc.
10. Detect ARP spoofing using nmap and/or opensource tool ARPWATCH and Wireshark.
11. Simulate DOS attack using Hping and other tools.
12. Set up IPSEC under LINUX.
13. Set up Snort (IDS) and study the logs.
14. Study experiment: scenario based or tools

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Textbooks:

1. Behrouz A. Ferouzan, "Cryptography & Network Security", 3rd Edition, Tata McGraw Hill, 2015.
2. William Stallings, "Cryptography and Network Security, Principles and Practice", 7th Edition, Pearson Education, 2017.
3. Atul Kahate, "Cryptography and Network Security", 3rd Edition, Tata McGraw Hill, 2017.
4. Bernard Menezes, "Cryptography & Network Security", 5th Edition, Cengage Learning, 2010.

Reference Books:

1. Bruce Schneier, "Applied Cryptography, Protocols Algorithms and Source Code in C", 2nd Edition, Wiley, 2006.
2. Mark Stamp, "Information Security Principles and Practice", 2nd Edition, Wiley, 2011.

Prepared by Checked by Head of the Department Principal

Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Machine Learning (DJS23ICMD601)
Course: Machine Learning Laboratory (DJS23ILMD601)

Pre-requisite: Basic Mathematics, Probability, and Python.

Course Objectives: This course aims to enable students to understand the fundamental concepts of Machine Learning and familiarize them with various machine leaning techniques used for predictive modelling. This course enables students to analyze and implement classification, Regression methods, and Reinforcement Learning methods, with a focus on improving model accuracy and generalization. Students will also learn to apply clustering algorithms and dimensionality reduction techniques for uncovering hidden patterns and simplifying complex datasets.

Course Outcomes: On successful completion of this course, students should be able to:

1. Apply appropriate evaluation metrics and dimensionality reduction techniques.
2. Apply a suitable machine learning algorithm for real world applications.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Machine Learning:** Definition and Types of Machine Learning, Train Set, Test Set, Bias vs Variance, Steps in ML Applications, Applications of Machine Learning, Issues in ML. Evaluation Metrics: Confusion Matrix, Precision, Recall, Accuracy, F1-Score, AUC-ROC Curve.	**04**
2	**Dimensionality Reduction:** Eigen values, Eigen vectors, Principal Component Analysis (PCA), Independent Component Analysis (ICA), Singular Value Decomposition (SVD), and Linear Discriminant Analysis (LDA). Applications: Feature Extraction Image Compression and Information Retrieval.	**08**
3	**Classification:** Types of Classification: Binary (Logistic Regression, Support Vector Machine (SVM)), Multi-class (KNN, Random Forest), Multi-label (Multi-label Random Forest). Lazy Learners (KNN), Eager Learners (SVM), Lazy Learners Vs Eager Learners. Linear Models (Logistic regression, SVM, LDA), Non-linear Models (SVM), Linear vs Non-linear Models. Applications: Image Recognition, Fraud Detection.	**08**
4	**Regression:** Simple and Multiple Linear Regression, Ridge, Lasso, Elastic Net, Support Vector Regression, Classification and Regression Trees (CART) using Gini Index. Applications: Weather Prediction, Stock Market Predication.	**07**
5	**Clustering:** Types of Clustering Methods, Hard vs Soft Clustering. Centroid-based: k-means. Density-based Clustering (Model-based Methods): DBSCAN. Fuzzy Clustering (Soft Clustering): Fuzzy C-means (FCM), Expectation-Maximization (EM). Applications: Sentiment Analysis, Recommendation Systems.	**07**
6	**Reinforcement Learning:** Core Concepts: agent, environment, state, action, reward. Core Components: Policy, Reward Signal, Value Function, Model. Formalism: Markov Decision Process (MDP), Policies and value functions. Algorithms: Key Features and Working of Q-learning and SARSA Techniques. Applications: AlphaGo Zero, Robotics and Industrial Automation.	**08**

List of Laboratory Experiments:

1. To perform data preprocessing and cleaning.
2. To implement dimensionality reduction techniques such as PCA, ICA, SVD for feature extraction and indexing.
3. To implement Logistic Regression to predict a categorical outcome, such as a yes/no or 0/1 prediction.
4. To implement Support Vector Machine to find the optimal hyperplane that maximizes the margin between classes.
5. To implement Linear Regression to model the relationship between a dependent variable and one or more independent variables.
6. Implementing CART decision tree algorithm for both classification and regression tasks.
7. To implement K-Nearest Neighbour to make a prediction for classification and for regression.
8. To implement DBSCAN clustering to group points into clusters of arbitrary shapes, while also detecting outliers.
9. To implement the Q-learning algorithm over multiple epochs by selecting actions based on rewards.
10. Mini project based on any machine learning application.

A minimum of six experiments from the above suggested list or any other experiment based on syllabus will be included along with the mini project, which would help the learner to apply the concept learnt.

Books Recommended:

Text books:

1. Ethem Alpaydın, "Introduction to Machine Learning", 4th Edition, The MIT Press, 2020.
2. Peter Harrington, "Machine Learning in Action", 1st Edition, Dreamtech Press, 2012.
3. Tom Mitchell, "Machine Learning", 1st Edition, McGraw Hill, 2017.
4. Andreas C, Müller and Sarah Guido, "Introduction to Machine Learning with Python: A Guide for Data Scientists", 1st Edition, O'reilly, 2016.
5. Kevin P. Murphy, "Machine Learning: A Probabilistic Perspective", 1st Edition, MIT Press, 2012.

Reference Books:

1. Dimitri P. Bertsekas, "A Course in Reinforcement Learning", 2nd Edition, Athena Scientific, 2025.
2. Aurélien Géron, "Hands-On Machine Learning with Scikit-Learn, Keras, and TensorFlow", 2nd Edition, Shroff/O'Reilly, 2019.
3. Witten Ian H., Eibe Frank, Mark A. Hall, and Christopher J. Pal., "Data Mining: Practical machine learning tools and techniques", 1st Edition, Morgan Kaufmann, 2016.
4. Han, Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2012.
5. Mehryar Mohri, Afshin Rostamizadeh, and Ameet Talwalkar, "Foundations of Machine Learning", 1st Edition, The MIT Press, 2012.
6. H. Dunham, "Data Mining: Introductory and Advanced Topics", 1st Edition, Pearson Education, 2006.

Prepared by Checked by Head of the Department Principal

Program: B. Tech. in Information Technology **T.Y B. Tech** **Semester: VI**

Course: Image Processing and Computer Vision (DJS23ICPE601)
Course: Image Processing and Computer Vision Laboratory (DJS23ILPE601)

Prerequisite: Basic Mathematics, C Programming, Java, Python

Course Objectives: The objective of the course is to introduce the concepts of image processing and basic analytical methods to be used in image processing. The course will also familiarize students with image enhancement, image restoration techniques, and image compression techniques. The course will introduce segmentation and morphological processing techniques along with motion analysis methods.

Course outcomes: On successful completion of this course, students should be able to:

1. Gain knowledge of the fundamentals of image processing and computer vision.
2. Apply Image enhancement techniques.
3. Apply image segmentation and morphological processing techniques to extract meaningful features from digital images.
4. Apply Image compression techniques.
5. Apply Optical flow techniques for motion analysis.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Digital Image Fundamentals:** Introduction to digital signals, Standard Discrete Time (DT) Signals, Concept of Digital Frequency, Representation of DT signal, Digital Image fundamentals, Image Sensing and acquisition, Steps in Digital Image Processing, Components Sampling and Quantization **Color Image Processing:** Color Fundamentals, Color models	03
2	**Image Enhancement (point processing):** Image Negative, Thresholding, Gray-level slicing with and without background, power law and log transform, Contrast Stretching, Histogram equalization, Image Enhancement in Spatial Domain (Neighbourhood processing): Low Pass and High Pass filtering for image enhancement, Basics of Spatial Filtering, Generating Spatial Filter Masks–Smoothing and Sharpening Spatial Filtering **Image Transforms:** 1-D DFT, 2-D Discrete Fourier Transform and Its Inverse, Some Properties of 2D DFT, Walsh -Hadamard, Discrete Cosine Transform, Haar Transform, Slant Transform. **Image Enhancement in Frequency Domain:** The Basics of Filtering in the Frequency Domain, Smoothing and Sharpening frequency domain filters	12
3	**Image Segmentation:** Based on Discontinuities, Line Detection, Edge Detection, Canny Edge Detection, Gradients using Masks, segmentation based on 2^{nd} order derivative, Hough Transform, Region Based Segmentation, Thresholding based segmentation. Harris Corner Detection, SIFT, SURF	08
4	**Image Morphology:** Erosion and Dilation, Opening and Closing, Basic Operations –Boundary extraction, Region Filling, Hit or-Miss Transformation. Feature extraction – Chain codes, Shape and Order.	06
5	**Image Compression:** Fundamentals of compression, Basic compression Methods, Huffman Coding, Arithmetic Coding, LZW Coding, Run-Length Coding, Improved Grey Scale Quantization (IGS), Transform Coding (JPEG), Predictive Coding.	08
6	**Introduction to computer vision:** Overview of Computer Vision, Vision for measurement, Vision for perception, interpretation, Visual search and organization, Applications of Computer vision.	05

	Optical Flow: Computations for motion estimation and depth calculation, Horn and Schunk, Lucas and Kanade algorithms, Motion Segmentation.	

List of Laboratory Experiments:

1. Explore various libraries of python for image processing.
2. Perform basic Image Manipulations like crop, flip, copy, scale, Conversion of RGB image to Grayscale and Black- and white and vice-versa, changing the intensity of a specific pixel.
3. Perform Image enhancement viz, Image Negative, Thresholding, Gray level slicing with and without background, Contrast Stretching.
4. Perform Histogram equalization.
5. To apply Spatial Filtering Enhancement Operations on a given image.
6. To apply Robert, Prewitt and Sobel Operators on an image and analyze the obtained output.
7. To perform edge detection on an image using LoG, DoG and Canny Edge Detection Techniques.
8. Apply Morphological operations.
9. To perform image compression.
10. Mini Project (CV based) and Technical Paper writing based on mini project.

Books Recommended:

Text books:

1. Rafel C. Gonzalez and Richard E. Woods, "Digital Image Processing", 4th Edition, Pearson Education Asia, 2018.
2. Sanjit Mitra, "Digital Signal Processing: A Computer Based Approach", 4th Edition, Tata McGraw Hill, 2013.
3. Anil K. Jain, "Fundamentals and Digital Image Processing", 3rd Edition, Prentice Hall of India.
4. Richard Szeliski, Computer Vision: Algorithms and Applications, Springer-Verlag London Limited, 2011.

Reference Books:

1. S. Salivahanan, A. Vallavaraj, C. Gnanapriya, "Digital Signal Processing", 4th Edition, Tata McGraw Hill Publication, 2019.
2. S. Jayaraman, E. Esakkirajan and T. Veerkumar, "Digital Image Processing", 1st Edition, Tata McGraw Hill Education Private Ltd, 2017.
3. S. Sridhar, "Digital Image Processing", 2nd Edition, Oxford university press, New Delhi, 2016.

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Program: Information Technology **T.Y B. Tech Semester: VI**

Course: Internet of Things (DJS23ICPE602)
Course: Internet of Things Laboratory (DJS23ILPE602)

Pre-requisite: Knowledge of Microcontrollers, Sensors, Wireless Networks.

Course Objectives: The objective of this course is to provide a comprehensive introduction to the interconnection and integration of physical devices and the Internet. The course familiarizes students with the concepts, applications, and protocols of IoT. The students will design and develop IoT based applications using different embedded boards like Arduino, Raspberry Pi, Intel Galileo etc.

Course Outcomes: On successful completion of this course, students should be able to:

1. Identify suitable enabler technologies for designing IoT based applications.
2. Analyze cloud data for IoT applications.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to IoT:** History of IoT, IoT Conceptual Framework, IoT Architectural View, Enabling Technologies of IoT, Major Components of IoT System, M2M Communication, Hardware Sources for IoT (Arduino, Intel Galileo, Intel Edison, Beagle Board, Raspberry Pi), Examples of IoT.	**05**
2	**Design Principles for Connected Devices:** IoT/M2M System Layers, Design Standardization, Communication Technologies (NFC, RFID, ZigBee, Bluetooth, WiFi), Web Communication Protocols, Message Communication Protocols, MQTT, Web Connectivity using SOAP, REST, and WebSockets.	**07**
3	**Internet Connectivity Principles:** Internet Based Communication, Internet Protocols (IPv4, IPv6, Routing Protocol for Low Power Lossy Networks), 6LoWPAN, TCP/IP, UDP, IP Addressing in IoT, Static and Dynamic IP address, DNS, DHCP, Application Layer Protocols (HTTP, HTTPS, FTP, TELNET).	**08**
4	**Data Computing using Cloud Platform:** Data Acquisition and Storage, Data Categorization for Storage, Organizing the Data, Data Processing and Analytics (Descriptive, Predictive, Prescriptive), Analytics using Big Data in IoT, Data Analytics Architecture, Cloud Computing Paradigm, Cloud Deployment Models (Public, Private, Community, Hybrid), Cloud Based IoT Services (XIVELY, NIMBITS).	**08**
5	**Sensors, RFIDs, and WSNs:** Sensor Technology (Resistive, Capacitive, Transistor-based sensors), Analog Sensors, Digital Sensors, Principle of RFID, RFID IoT Systems, Components of RFID System, RFID Technological and Security Challenges, RFID Applications, WSN Architecture (Layered Architecture, Multi-Cluster Architecture), WSN Protocols (S-MAC, SPINS, SNEP, μ-TESLA), WSN IoT Applications.	**08**
6	**IoT Privacy, Security, and Vulnerability Solutions:** Introduction, Privacy, Vulnerability of IoT, Role of OWASP, Security Requirements, Threat Analysis, Layered Attacker Model (LAM), Possible attacks in LAM, Solutions for Mitigating Attacks, Identity Management, Access Control.	**06**

Lab guidelines for mini project:

1. The mini project work is to be conducted by a group of three students (four in extreme case; call can be taken by subject in-charge).
2. The group should meet with the faculty concerned during laboratory hours and document the progress of work
3. The students should be given sufficient time (6-8 hrs) to do a survey for finalizing their mini project topic using Raspberry Pi / Arduino / ARM Cortex / Intel Galileo etc.

4. Each group will identify a potential problem statement on which the study and implementation is to be conducted and will also identify the hardware and software requirements for their mini project.
5. Once the topic has been finalized, students can either buy the required components by themselves or can request the college to provide the components.
6. Concerned faculty will do the term work assessment after seeing the group's presentation and overall implementation of the mini project.
7. Each group may present their work in various project competitions and paper presentations.
8. A detailed report is to be prepared as per guidelines given by the concerned faculty.

Books Recommended:

Text books:

1. Raj Kamal, "Internet of Things: Architecture and Design Principles", 1st Edition, Mc Graw Hill, 2017.
2. Hakima Chaouchi, "Internet of Things: Connecting Objects to the Web", 1st Edition, Wiley, 2013

Reference Books:

1. Adrian McEwen, Hakim Cassimally, "Designing the Internet of Things", 1st Edition, Wiley, 2013.
2. Dr. Ovidiu Vermesan, Dr. Peter Friess, "Internet of Things: Converging Technologies for Smart Environments and Integrated Ecosystems", 1st Edition, River Publishers, 2013.
3. Vijay Madisetti, Arshdeep Bahga, Internet of Things (A Hands-On-Approach), 1st Edition, Orient Blackswan Private Limited - New Delhi, 2015.

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Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Infrastructure Security (DJS23ICPE603)
Course: Infrastructure Security Laboratory (DJS23ILPE603)

Pre-requisite: Knowledge of
1. Computer Networks

Course Objectives: The course introduces students to the underlying principle of securing the IT infrastructure with the help of different prevention techniques and policies.

Course Outcomes: On successful completion of this course, students should be able to:
1. Gain comprehensive knowledge of access control policies, multilevel security, and AAA models.
2. Proficient in identifying and addressing software vulnerabilities, operating system security, and database security.
3. Apply cloud data security strategies, encryption practices, key management, and compliance with industry or regulatory requirements.
4. Evaluate enterprise mobility security frameworks, secure communication strategies, and deception-based defenses against mobile/IoT attacks.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Access Control Policies and Multilevel Security:** Cyber Threats, Cyber-attacks – Stages, Malware and types, **Multilevel Security**: Access Control Policies and Models (DAC, MAC, RBAC, ABAC, BIBA, Bell La Padula), AAA model: Authentication and Access Control Services- RADIUS, TACACS+ **SAN Security:** LUN Masking, SAN Zoning Port Authentication.	**06**
2	**Software Security:** **Software Vulnerabilities:** Buffer overflow, Format String, Cross-Site Scripting, SQL Injection, **Operating System Security:** Memory and Address Protection, File Protection Mechanism, User Authentication. Linux and Windows: Vulnerabilities, File System Security. **Database Security:** Database Security Requirements, Reliability and Integrity, Sensitive Data, Inference Attacks, Multilevel Database Security,	**08**
3	**Web Security:** Wireless Security Mobile Device Security- Security Threats, Device Security, End to End Encryptions, Security Protocols and Mechanisms, OWASP Top Ten, Input Validation and Sanitization, Authentication and Session Management, Cookies, SSL, HTTPS, SSH, Browser Attacks, Account Harvesting, Web Bugs, Clickjacking, CrossSite Request Forgery, Security Testing and Vulnerability Scanning, Incident Response and Web Security Monitoring.	**07**
4	**Mobility Security:** Role of mobile devices in enterprise infrastructure, Mobile threat landscape, Attack vectors: Wi-Fi, Bluetooth, NFC, mobile networks, Mobile Operating System Security: Android vs. iOS security models, Application sandboxing & permission models **Device & Application Security**: Mobile Device Management (MDM) and Enterprise Mobility Management (EMM), Application whitelisting, blacklisting, and secure distribution, Mobile application vulnerability scanning & testing **Secure Mobile Communications:** Secure Wi-Fi, VPNs, and end-to-end encryption for mobile traffic **Mobility Security and Deception:** Mobility Security, IMSI Catching, IoT Security, IoT Botnets, Using Deception and Honey Pots for Security.	**07**

5	**Hybrid Cloud Security**: Cloud Security Fundamentals, Cloud Security as a Service Cloud Identity, Access, and Federation: Cloud Identity and Access Management (IAM), Federated Identity Management (SAML, OAuth), Cloud Migration Security Considerations, Cloud Configuration & Patch Management, **Data Protection Techniques:** Encryption & Key Management, Egress Monitoring, Masking, Obfuscation, Anonymization, Tokenization, Cryptographic Erasure Cloud Data Asset Management, Types of Cloud Assets & Asset Management Pipeline, Tagging Cloud Assets **Hybrid Cloud Security:** Enterprise Shift to Hybrid Cloud, Advanced Hybrid Cloud Security Architecture	**08**
6	**Administering Security:** Introduction to Security Administration: Role of security administration in infrastructure security, Responsibilities of a security administrator Security governance, risk, and compliance (GRC) overview Security plans- Business continuity plan, Incident response plan, Risk Analysis- Nature of risk, steps of risk analysis, Organizational Security Policies, End Point Security Best Practices, Defining Endpoints, Why Security Fails, Missing Link Discovered, Endpoints and Network Integration, Trustworthy Beginnings, Threat Vectors, Case Studies of Endpoint Security Failures.	**06**

List of Laboratory Experiments:

1. Installing and exploring Kali Linux and the inbuilt tools for reconnaissance and ethical hacking.
2. Implementation and analysis of SQL injection Attack.
3. Implementation of Buffer overflow attack and its analysis using Splint, Cppcheck etc.
4. Exploring Authentication and access control using RADIUS, TACACS and TACACS+.
5. Configuration of mod Security, core rule set on Apache server.
6. Detecting Prompt Injection in Large Language Models.
7. Understand secure remote access using VPNs.
8. Implement Amazon GuardDuty to identify and detect any atypical or potentially suspicious activities occurring within your AWS account or systems.
9. Study and Implement Amazon CloudWatch Logs, Azure Monitor, Google Stackdriver Logging, to provide robust log storage and retrieval capabilities to store and query log data for monitoring and analysis.
10. Study and apply various IDS tools viz. CloudFlare, Akamai, and Signal Sciences to provide cloud-based web application firewall solutions.
11. Exploring various tools for Infrastructure Security: Firewall, antimalware systems, Penetration testing and network vulnerability analysis tools, intrusion detection system, Authentication software, Password auditing tools, Encryption tools, Security information and event management (SIEM) tools.
12. Explore vulnerability scanning tool (e.g., Nessus) to scan the system for potential vulnerabilities.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Text books:

1. William Stallings and Lawrie Brown, "Computer Security: Principles and Practice", 6th Edition, Pearson Education, 2014.
2. Charles P. Pfleeger, Shari Lawrence Pfleeger, and Lizzie Coles-Kemp, "Security in Computing", 6th Edition, Pearson Education, 2023.
3. Chris Dotson, "Practical Cloud Security", 2nd Edition, O'Reilly Media, 2019.
4. Mark Kadrich, "Endpoint Security", 1st Edition, Addison-Wesley, 2007.

Reference Books:

1. Rafay Baloch, "Ethical Hacking and Penetration Testing Guide", CRC Press, 2015.
2. Tim Boyles, "CCNA Security Study Guide: Exam 640-553", Wiley (Sybex), 2010.

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Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Big Data Analytics (DJS23ICPE604)
Course: Big Data Analytics Laboratory (DJS23ILPE604)

Pre-requisite: Knowledge of Data Mining Algorithm.

Course Objectives: The objective of this course is to provide students with a solid foundation in Big Data concepts, tools, and frameworks, including Hadoop and its ecosystem. It focuses on developing analytical and technical skills for processing, managing, and analyzing massive datasets, along with understanding security, privacy, and governance challenges in Big Data systems.

Course Outcomes: On successful completion of this course, students should be able to:

1. Identify big data characteristics, its applications and the challenges associated with big data.
2. Explore Big Data Frameworks and Hadoop Ecosystem with their roles in solving Big Data problems.
3. Apply advanced data mining algorithm for big data analytics.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Big Data:** Introduction to Big Data Framework, Types of Big Data, Big Data characteristics, Big Data Storage techniques, Traditional vs. Big Data business approach, Big Data Challenges, Big data on Cloud, Big Data Applications (Examples of Big Data in Real Life), Latest trends in Big Data.	04
2	**Big Data Frameworks:** Introduction to Hadoop, Core Hadoop Components, Hadoop Distributed File System (HDFS) & Architecture, YARN, MapReduce –The Map Tasks, The Reduce Tasks, Combiners, Details of MapReduce Execution, MapReduce Algorithms and applications. **Hadoop Ecosystem**: Introducton to Hadoop Ecosystem components, Reading and Writing Large Datasets – Apache PIG, Apache HIVE, Apache HBASE, Apache Sqoop, Apache Oozie, Apache Zookeeper, Apache Kafka, Apache Cassandra, Apache Flink, Apache Airflow.	10
3	**Mining Big Data Streams:** Introduction to Data stream mining, The Stream Data Model - A DataStream-Management System, Examples of Stream Sources, Stream Queries, Issues in Stream Processing, Sampling Data in a Stream- Sampling Techniques, Filtering Streams-The Bloom Filter, Counting Distinct Elements in a Stream - The Flajolet-Martin Algorithm, Combining Estimates, Space Requirements, Estimating Moments- Alon-Matias-Szegedy Algorithm, Counting Ones in a Window - The Cost of Exact Counts, The Datar-Gionis-Indyk Motwani Algorithm and Query Answering in the DGIM Algorithm, Decaying Windows.	08
4	**Frequent Pattern Mining:** Market Baskets and the A-Priori Algorithm, Handling Larger Datasets in Main Memory, Basic Algorithm of Park, Chen, and Yu, The SON Algorithm and MapReduce. **Clustering Algorithms:** Bradley-Fayyad-Reina (BFR) Algorithm, CURE Algorithm, Canopy Clustering, Clustering with MapReduce.	06
5	**Big Data Analytics Applications:** **Link Analysis** - Introduction to Graph Theory, Graph data in real-world (social, transport, web), PageRank, - Topic Sensitive Page Rank, Link Spam, Hubs and Authorities, HITS Algorithm, Community detection algorithms. **Mining Social: Networ**k Graphs - Social Networks as Graphs, Types of Social Networks, Clustering of Social Network Graphs, Clique Percolation Method. **Machine Learning:** Introduction to Machine Learning on Big Data, Challenges in applying ML on Big data, ML pipelines for Big Data, Introduction to MLlib.	08

6	**Security, Ethics & Governance in Big Data:** Security challenges in big data environments, Security protocols and standards in big data platforms, Access control in Big Data platforms, Case studies on security breaches in big data systems, Principles of data privacy, Techniques for data anonymization and pseudonymization, Risks and limitations of anonymization, Privacy-preserving data mining, Ethical implications of data anonymization, Overview of global data protection regulations (GDPR, HIPAA, CCPA, etc.), Compliance requirements for big data systems, Data governance and lineage.	**06**

List of Laboratory Experiments:

1. Install and configure a small Hadoop cluster using virtual machines or cloud services.
2. Implement HDFS commands on Hadoop:
3. To apply MapReduce to implement Word Count algorithm.
4. To implement Matrix Vector Multiplication with Hadoop Map Reduce.
5. To install and Run Pig to write Pig Latin scripts to sort, group, join, project, and filter data.
6. To install and Run Hive then use Hive to create, alter, and drop databases, tables, views, functions, and indexes.
7. Set up HBase and perform Create, Read, Update, and Delete operations on data stored in HBase tables.
8. To perform NoSQL database using Mongo dB to create, update and insert.
9. To write Spark application to perform data Analysis using PySpark.
10. Explore technologies like Apache Kafka for real-time data streaming and processing.
11. To implement Bloom Filters for filter on Stream Data in C++/java/ Scala.

Any other experiment based on syllabus may be included, which would help the learner to understand topic/concept.

Books Recommended:

Textbooks:

1. Anand Rajaraman, Jeff Ullman, "Mining of Massive Datasets", 2nd Edition, Cambridge University Press, 2014.
2. Radha Shankarmani, M Vijayalakshmi, "Big Data Analytics", 2nd Edition, Wiley Publications, 2016.
3. Tom White, "Hadoop: The Definitive Guide", 4th Edition, O'Reilly Media, Inc., 2015
4. Alex Holmes, "Hadoop in Practice", 2nd Edition, Manning Press, Dreamtech Press, 2015.
5. Han, Kamber, "Data Mining Concepts and Techniques", 3rd Edition, Morgan Kaufmann, 2011.
6. Sunil Soares, "Big Data Governance: An Emerging Imperative", MC Press, 2012.

Reference Books:

1. Bart Baesens, "Analytics in a Big Data World: The Essential Guide to Data Science and its Applications", 1st Edition, Wiley Big Data Series, 2017.
2. Vignesh Prajapati, "Big Data Analytics with R and Hadoop", 1st Edition, Packt Publishing Limited, 2013.
3. Tom White, "Hadoop: The Definitive Guide", 3rd Edition, O'Reilly Publications, 2016.
4. Paola Palomino-Flores, Ricardo Cristi-Lopez, Edison Medina La Plata, David Paul, "Ethics and Security in the Era of Big Data: Innovative Challenges and Educational Strategies", SpringerLink, 2024.

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Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Game Design (DJS23ICPE605)
Course: Game Design Laboratory (DJS23ICPE605)

Pre-requisite: Basic knowledge of HCI, UI/UX and Computer Graphics.

Course Objectives: This course aims to introduce students to the basics of game design, gamification and virtual reality, helping them understand how to create simple and engaging interactive experiences.

Course Outcomes: On successful completion of this course, students should be able to:

1. Design games using fundamental game design principles.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Game Design:** Motivation, Types of games, Different aspects of game design; Different components in a game, Game engines, Design Schemas, Game Design Fundamentals.	04
2	**The Design Process:** Iterative Design, Commissions, Game creation, Game Modification, Game Analysis, Design Process, Four Semiotic concepts, Play Testing, Game Mechanics and Dynamics: Feedback and Re-enforcement, Types of Rules: constitutive, operational, and implicit.	08
3	**Game Design Elements:** Game Mechanics: Space, Objects, Attributes, and States, Actions, Rules, Skill, Chance. Balance in Game Mechanics: The Twelve Most Common Types of Game Balance, Game Balancing Methodologies, Balancing Game Economies, Dynamic Game Balancing, The Big Picture. Designing the Player Experience: The Loop of Interaction, Channels of Information, Other Interface Tips Indirect Game Control: The Feeling of Freedom, Constraints, Goals, Interface, Visual Design, Characters, Music; Characters: Nature of Game Characters, Avatars, Creating Compelling Game Characters. Spaces: The Purpose of Architecture, Organizing your Game Space, Real vs. Virtual Architecture, Level Design.	08
4	**Game Analysis:** Game Analysis: Octalysis Framework, 8 Core Drives of motivation, White Hat vs. Black Hat gamification, Case study: Applying Octalysis to Duolingo or a fitness app, Rethinking 'playing the game' with Jacques Henriot, To Play Against: Describing Competition in Gamification, Player Motivation: Powerful Human Motivators, Player types, Social Games, Intrinsic verses Extrinsic, Motivation, Progression to Mastery.	08
5	**Introduction and Integration of VR in Game Design:** Foundations of VR in Game Design: Definition and Scope of VR, Types of VR, Characteristics of VR, Basic VR environments, Limitations of VR environments, Immersion Vs Presence, Key hardware requirements for VR, Evolution and history of Virtual Reality in gaming, Traditional (2D/3D) games v/s fully immersive VR experiences, Gameplay mechanics for VR, Designing player roles and perspectives in VR, Spatial Storytelling and Environment Design. User Interface and Interaction in VR: User Monitoring, Position Tracking, Body Tracking, Physical input Devices, Speech Recognition (Audio Input) and World Monitoring: Persistent Virtual Worlds, Bringing the Real World into the Virtual World. Output: Visual Displays: Properties, types, Aural Displays Haptic Displays.	08

6	**Gamification:** Definition of Gamification, Why Gamify, Examples and Categories, Gamification in Context, Resetting Behaviour, Replaying History, Gaming foundations: Fun Quotient, Evolution by loyalty, status at the wheel, the House always wins.	**06**

List of Laboratory Experiments:

1. To propose an original game idea by identifying its genre, theme, objectives, and target players based on player motivation principles.
2. To identify core components of the selected game— mechanics, dynamics, aesthetics, rules, and space.
3. To create a storyboard and level plan that shows how the game will progress, including its story, challenges, and player journey.
4. To build a simple playable version of the game with basic controls, environment setup, and main features using a game engine such as Unity or Unreal.
5. To add important game mechanics like actions, scoring, power-ups, and challenges, and see how they change the gameplay experience.
6. To improve user experience through effective interface design, feedback loops, audio-visual cues, and reinforcement mechanisms.
7. To design compelling main and supporting characters along with immersive game environments that align with narrative and emotional design principles.
8. To conduct structured playtesting sessions, collect user feedback, and iteratively refine the game design for improved playability and engagement.
9. To apply gamification elements such as achievements, rewards, and progression systems using frameworks like Octalysis to increase player motivation.
10. To explore immersive game design by integrating VR elements or advanced input/output devices, enhancing player presence and interactivity.
11. To compile all developed components into a complete playable game, perform final testing, and present the game with a comprehensive Game Design Document (GDD).

Books Recommended:

Textbooks:

1. Katie Salen and Eric Zimmerman, “Rules of Play: Game Design Fundamentals”, MIT Press, 2003.
2. Ernest Adams, “Fundamentals of Game Design”, 3rd Edition, New Riders, 2013.
3. Mathias Fuchs, Sonia Fizek,Paolo Ruffino, Niklas Schrape, “Rethinking Gamification”, 1st Edition, Meson Press, 2021.
4. William R Sherman and Alan B Craig, “Understanding Virtual Reality: Interface, Application and Design”, 1st Edition, Morgan Kaufmann Publishers, 2002.
5. Jesse Schell, “The Art of Game Design: A Book of Lenses”, CRC Press, 2008.

Reference Books:

1. Scott Nicholson, “A User-Centered Theoretical Framework for Meaningful Gamification”, Proceedings of the 8th Games Learning and Society Conference, 2012.
2. Roger E. Pedersen, “Game Design Foundations”, Jones & Bartlett Learning, 2nd Edition, 2009.
3. Alan Craig, William Sherman and Jeffrey Will, “Developing Virtual Reality Applications, Foundations of Effective Design”, 1st Edition, Morgan Kaufmann, 2009.
4. Steven M. LaValle, “Virtual Reality”, 1st Edition, Cambridge University Press, 2016.

Program: B. Tech. in Information Technology **T.Y B. Tech** **Semester: VI**

Course: Enterprise Governance of Information Technology (DJS23ICPE606)
Course: Enterprise Governance of Information Technology Lab (DJS23ILPE606)

Prerequisite: NA

Course Objectives: This course provides an in-depth understanding of Business/IT alignment, IT governance frameworks, and IT business value assessment. Students will explore COBIT, AI-driven governance, and enterprise IT strategies for effective decision-making and organizational success.

Course outcomes: On successful completion of this course, students should be able to:

1. Analyze IT governance frameworks for effective Business/IT alignment.
2. Apply AI techniques to enhance IT governance and decision-making.
3. Evaluate IT business value using productivity measures and governance models.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Business/IT Alignment:** Business/IT Alignment, Measuring Business/IT Alignment, Matching and Moderation Approach, Profile Deviation Approach, Scoring Approach, Maturity Model Approach, Relationship Between Enterprise Governance of IT and Business/IT Alignment, Multidimensional View, Social Business/IT Alignment.	07
2	**Enterprise Governance of IT:** Genesis and Evolution of IT Governance, Academic Research Stages, Practitioner and Academic Perspectives, Mechanisms for Implementing IT Governance, Principles of IT Governance, Case Study: Enterprise Governance of IT at KLM, EGIT Benefits.	07
3	**IT Governance Frameworks and Models:** Board-Level EGIT, IT Governance Transparency, Inter-organizational IT Governance, Ambidextrous IT Governance, Viable EGIT, IT Governance Capita Selecta.	07
4	**IT Business Value:** IT Business Value, IT Productivity Paradox, IT Productivity Cycle, Business Case Process, IT Balanced Scorecard, IT BSC Core Concepts, IT BSC Project and Organization, EGIT-Alignment-Value Relationship.	07
5	**COBIT as a Framework for Enterprise IT Governance:** COBIT History, COBIT 2019 Framework, COBIT 2019 Principles, Strategic Alignment and Balanced Scorecard, Governance vs. Management (ISO/IEC 38500), Enterprise Goals, Alignment Goals, COBIT Performance Management, Leveraging COBIT in Practice.	07
6	**Artificial Intelligence and IT Governance:** Scope of Governance, Governance – A Short Review, Data and Information Governance, Infusing AI into Data Governance, Governance in the Context of AI, Beyond Traditional Information Governance, Challenges for AI Governance, Regulations Driving AI Governance, Key Aspects of AI Governance including Rules and Policies.	07

List of Laboratory Experiments:

1. Develop a python program to measure Business/IT alignment using Scoring, Profile Deviation, and Maturity Model with visualizations.
2. Develop an IT governance decision system using Python and Scikit-learn's decision-tree algorithm.
3. Implement a dashboard using Power BI or Tableau to visualize IT governance performance metrics derived from the IT Balanced Scorecard approach.
4. Create a Python program to map enterprise goals to governance objectives using COBIT 2019, Pandas, and Streamlit.

5. Implement a risk assessment model using AI techniques such as NLP (Natural Language Processing) to analyze governance policies. Use Python's NLTK or spaCy libraries.
6. Use NetworkX in Python to model inter-organizational IT governance relationships and identify key governance influences.
7. Develop a compliance verification tool using AI and machine learning (TensorFlow or Scikit-learn) to automatically check IT policies against industry regulations.
8. Develop a Python-based data governance model with SQL for data lineage, classification, search, and metadata visualization.
9. Conduct a case-study-based analysis comparing COBIT, ITIL, and ISO/IEC 38500 frameworks, presenting findings in a structured report.
10. Study AI-driven IT governance models, regulatory challenges, and future trends through a literature review.

Books Recommended:

Text books:

1. Steven De Haes, Wim Van Grembergen, Anant Joshi, Tim Huygh, "Enterprise Governance of Information Technology: Achieving Alignment and Value in Digital Organizations", 3rd Edition, Springer, 2020.

Reference Books:

1. Eberhard Hechler, Martin Oberhofer, Thomas Schaeck, "Deploying AI in the Enterprise: IT Approaches for Design, DevOps, Governance, Change Management, Blockchain, and Quantum Computing", Apress, 2020.
2. Peter Weill, Jeanne W. Ross, "IT Governance: How Top Performers Manage IT Decision Rights for Superior Results", Harvard Business Review Press, 2004.
3. Gad J. Selig, "Implementing Effective IT Governance and IT Management", Van Haren Publishing, 2015.

Weblinks:

1. https://www.coursera.org/specializations/ai-for-business-wharton
2. https://www.cognitusea.com/ai-trainings/ai-governance-training

Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Cloud Computing (DJS23ICPE607)
Course: Cloud Computing Laboratory (DJS23ILPE607)

Pre-requisite: Operating System, basic networking and Database Fundamentals.

Course Objectives: This course aims to provide a comprehensive understanding of cloud computing principles, virtualization techniques, cloud architecture, and deployment models, along with the processes involved in migrating applications to the cloud. It also focuses on developing an understanding about management of cloud infrastructure using services like VPC, EC2, cloud-based storage, and DBaaS, while emphasizing robust cloud security, data protection measures, and access control through administrative frameworks.

Course Outcomes: On successful completion of this course, students should be able to:
1. Summarize the fundamental concepts of cloud computing and virtualization.
2. Describe the roles and functions of cloud infrastructure components, cloud storage services, and Database-as-a-Service offerings.
3. Analyze cloud security concepts, data protection mechanisms, identity management, and administrative controls.

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Introduction to Cloud Computing:** Cloud Engineering, Layers and Types of Clouds, Cloud Infrastructure Management, AI-driven Cloud Management, Challenges, and Applications. Virtualization: Virtualization of Computing, Storage and Resources. Cloud Services: Introduction to Cloud Services IaaS, PaaS and SaaS **Virtualization:** Characteristics of virtualized environments, Taxonomy of virtualization techniques: hosted, bare-metal, Hypervisor and Xen Architecture, Para virtualization with Compiler Support, CPU Virtualization, Other Virtualizations: Storage, Network, Desktop and Application Server Virtualization, Virtualization and cloud computing.	**08**
2	**Cloud Computing Architecture:** The cloud reference model: SAAS, IAAS, PAAS, Serverless Computing (Function-as-a-Service), Types of clouds: Public, Private Hybrid, Community, Multi-Cloud and Hybrid Cloud Management, Economics of the cloud, Open challenges. **Migrating Applications to the Cloud:** Key aspects, cloud migration techniques, phases during migration, cloud emulators.	**06**
3	**Virtual Private Cloud (VPC):** Introduction to VPC and its benefits, Networking concepts within a VPC (subnets, route tables, security groups), VPC peering and connectivity options, VPC design best practices and considerations. **Elastic Compute Cloud (EC2) Service:** Overview of EC2 and its role in cloud computing, EC2 instance types and families, Provisioning and launching EC2 instances, configuring security groups and key pairs, Managing EC2 instances (start, stop, terminate), Elastic IP addresses and Elastic Network Interfaces (ENIs).	**08**
4	**Cloud-Based Storage:** Provisioning Cloud Storage, Exploring Cloud Backup Solutions, Cloud Storage Interoperability. **Database as a Service:** Key advantages of Database as a service offering, Amazon S3, Elastic Block Store (ESB), Amazon SimpleDB.	**06**

5	**Understanding Cloud Security:** Securing the Cloud: The security boundary, Security service boundary, Security mapping, Securing Data: Brokered cloud storage access, Storage location and tenancy, Encryption, Auditing and compliance, Establishing Identity and Presence, Identity protocol standards: Windows Azure identity standards. Zero-Trust Cloud Architecture. **Data Protection:** Concepts of data protection in cloud environments; securing data at rest and in transit; encryption mechanisms in Amazon S3; comparison of client-side and server-side encryption (CSE vs SSE); overview of AWS services and tools for data protection and compliance, Disaster Recovery in Clouds.	**08**
6	**Administration for Clouds:** The AAA model, single sign-on for clouds, industry implementation for AAA, authentication management standards for controlling access, SAML, OAuth 2.0, authorization management, accounting for resource utilization.	**06**

List of Laboratory Experiments: (Any 8-10 expt. Based on either AWS / AZURE/ GCP/ OCI)

1. Virtualisation: Hosted Virtualisation, Bare Metal Virtualisation
2. Host a Static Website on cloud.
3. Create and migrate relational database on cloud.
4. Create Virtual Private Clouds and establish connections between each other.
5. Implement user level authentication on your cloud applications.
6. Implement Load balancing on your created cloud application.
7. Automate Infrastructure Development.
8. Implement serverless architecture and configure notification services.
9. Implement Hybrid storage and Data Migration.
10. Deploying a Cloud Instance on AWS EC2.
11. Setting Up a Virtual Private Cloud (VPC).
12. Explore cloud storage options and create backup solutions.
13. Configuring Elastic Block Store (EBS) with EC2 instances.
14. Implement security best practices for cloud resources.
15. Cost Monitoring of a Kubernetes Application using any tool.
16. Multi-Cloud Cost Comparison: “Deploy, Measure & Compare” using any tool

Books Recommended:

Text books:

1. Kailash Jayaswal, Jagannath Kallakurchi, Donald J. Houde, Dr. Deven Shah, “Cloud computing Black Book”, 1st Edition, Dreamtech Publication, 2014.
2. Rajkumar Buyya, “Mastering Cloud Computing”, 2nd Edition, McGraw Hill Education, 2017.
3. Ray Rafaels, “Cloud Computing: From Beginning to End”, 1st Edition, CreateSpace Independent Publishing, 2015.

Reference Books:

1. Temitayo Fagbola, Kamal Kant Hiran, “Cloud Computing: Master The Concepts, Architecture and Applications with Real-World Examples and Case Studies”, 1st Edition, BPB Publications, 2019.
2. Dr. Sunilkumar, S. Manvi, “Cloud Computing: Concepts and Technologies”, 1st Edition, CRC Press, 2021.
3. Ricardo Puttini, Thomas Erl, and Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, 1st Edition, Pearson Publication, 2013.
4. Michael J Kavis”, Architecting the Cloud”, 1st Edition, Wiley, 2014.
5. Thomas Erl, Zaigham Mahmood, “Cloud Computing: Concepts, Technology & Architecture”, 2nd Edition, Pearson Education, 2014.

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Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Innovative Product Development IV (DJS23IPSCX04)

Pre-requisite: NA

Course Objectives:

1. To acquaint the students with the process of identifying the need (considering a societal requirement) and ensuring that a solution is found out to address the same by designing and developing an innovative product.
2. To familiarize the students with the process of designing and developing a product, while they work as part of a team.
3. To acquaint the students with the process of applying basic engineering fundamentals, so as to attempt at the design and development of a successful value-added product.
4. To inculcate the basic concepts of entrepreneurship and the process of self-learning and research required to conceptualize and create a successful product.

Course Outcomes: On successful completion of this course, students should be able to:

1. Identify the requirement for a product based on societal/research needs.
2. Apply knowledge and skills required to solve a societal need by conceptualizing a product, especially while working in a team.
3. Use standard norms of engineering concepts/practices in the design and development of an innovative product.
4. Draw proper inferences through theoretical/experimental/simulations and analyses the impact of the proposed method of design and development of the product.
5. Develop interpersonal skills while working as a member of the team or as the leader.
6. Demonstrate capabilities of self-learning as part of the team, leading to life-long learning, which could eventually prepare themselves to be successful entrepreneurs.
7. Demonstrate product/project management principles during the design and development work and also excel in written (Technical paper preparation) as well as oral communication.

Guidelines for the proposed product design and development:

- Students shall convert the solution designed in semester 3 and 4 into a working model, using various components drawn from their domain as well as related interdisciplinary areas.
- The working model is to be validated with proper justification, and the report is to be compiled in a standard format and submitted to the department. Efforts are to be made by the students to try and publish the extended technical paper, either in the institute journal, “Techno Focus: Journal for Budding Engineers” or at a suitable publication, approved by the department research committee/ Head of the department.
- Faculty supervisor may provide inputs to students during the entire span of the activity, spread over 2 semesters, wherein the main focus shall be on self-learning.
- A record in the form of an activity logbook is to be prepared by each team, wherein the team can record weekly progress of work. The guide/supervisor should verify the recorded notes/comments and approve the same on a weekly basis.
- The focus should be on self-learning, capability to design and innovate new products as well as on developing the ability to address societal problems. Advancement of entrepreneurial capabilities and quality development of the students through the yearlong course should ensure that the design and development of a product of appropriate level and quality is carried out, spread over two semesters, i.e. during the semesters V and VI.

Guidelines for Assessment of the work:

- The review/ progress monitoring committee shall be constituted by the Head of the Department. The progress of

design and development of the product is to be evaluated on a continuous basis, holding a minimum of two reviews in each semester.

- In the continuous assessment, focus shall also be on each individual student's contribution to the team activity, their understanding and involvement as well as responses to the questions being raised at all points in time.
- Oral examination should be conducted by Internal and External examiners. Students have to give presentation and demonstration on their working model
- The distribution of marks for term work shall be as follows:
    1. Marks awarded by the supervisor based on logbook: 10
    2. Marks awarded by review committee: 10
    3. Quality of the write-up: 05

The overall work done by the team shall be assessed based on the following criteria.

1. Quality of survey/ need identification of the product.
2. Clarity of Problem definition (design and development) based on need.
3. Innovativeness in the proposed design.
4. Feasibility of the proposed design and selection of the best solution.
5. Cost effectiveness of the product.
6. Societal impact of the product.
7. Functioning of the working model as per stated requirements.
8. Effective use of standard engineering norms.
9. Contribution of each individual as a member or the team leader.
10. Clarity on the write-up and the technical paper prepared.

The semester reviews (V and VI) may be based on relevant points listed above, as applicable.

Guidelines for Assessment of Semester Reviews:

- The write-up should be prepared as per the guidelines given by the department.
- The design and the development of the product shall be assessed through a presentation and demonstration of the working model by the student team to a panel of Internal and External Examiners, preferably from industry or any research organizations having an experience of more than five years, approved by the Head of the Institution. The presence of the external examiner is desirable only for the 2nd presentation in semester VI. Students are compulsorily required to present the outline of the extended technical paper prepared by them during the final review in semester VI.

Prepared by | Checked by | Head of the Department | Principal

Program: Information Technology **T.Y B. Tech** **Semester: VI**

Course: Environmental Science (DJS23ICHSX10)

Pre-requisite: Interest in Environment and its impact on Human

Course Objectives:

1. Familiarise students with environment related issues such as depleting resources, pollution, ecological problems and the renewable energy scenario.
2. Give overview of Green Technology options.

Course Outcomes: On successful completion of this course, students should be able to:

1. Understand how human activities affect environment
2. Understand the various technology options that can make a difference

Detailed Syllabus: (unit wise)

Unit	Description	Duration
1	**Air Pollution** i. Air Quality Index ii. Case study on Smog	01
2	**Water Pollution** Presentation on Water Pollution (Industrial, Sewage, etc.) explaining any specific case.	01
3	**Noise Pollution** i. Decibel limits for hospital, library, silence zone ii. List effects of noise pollution on human health iii. Measure decibel level in college library, canteen, classroom	01
4	**Biodiversity loss** Case study on effect of pollution on biodiversity loss.	01
5	**Deforestation** Debate for and against "To promote Economic Growth Deforestation is required."	01
6	**Renewable Energy sources** Presentation on different Renewable Energy Technologies	01
7	**Climate change** Report on major Impact of Global warming on Environment giving real examples**.**	01
8	**Green Technology** Advantages and Examples of Green Building for Sustainable development, Sustainable Software Design, Data Center Energy Efficiency, Thin-Client and Energy Efficiency.	01

Books Recommended:

Text books:

1. R. Rajagopalan, "Environmental Studies from Crisis to Cure", 2nd Edition, Oxford university press, 2011.
2. Erach Bharucha, "Textbook of Environmental Studies for Undergraduate Courses",
3. Mohammad Dastbaz, Colin Pattinson, Babak Akhgar, Morgan and Kaufman, "Green Information Technology a Sustainable Approach", Elsevier, 2015.

Reference Books:

1. Paulina Golinska, Marek Fortsch, Jorge Marx-Gómez, "Information Technologies in Environmental Engineering: New Trends and Challenges", Springer, 2011

Websites:

1. CITES: www.cites.org
2. Convention on Biological Diversity: www.biodiv.org
3. Kalpvriksh: www.kalpvriksh.org
4. Water pollution: http://en.wikipedia.org/wiki/Water_polution
5. Ecosan: www.eco-solutions.org

List of Tutorials

SN.	Tutorial List
1	Case study on Smog.
2	Presentation on Water Pollution (Industrial, Sewage) explaining any specific case.
3	List effects of noise pollution on human health. Measure decibel level in college library, canteen, classroom
4	Case study on effect of pollution on Biodiversity loss.
5	Debate for and against to promote Economic Growth Deforestation is required.
6	Presentation on different Renewable Energy Technologies.
7	Report on major impact of Global warming on Environment giving real examples.
8	Report on advantages and examples of Green Building for Sustainable development, Sustainable Software Design.

Prepared by Checked by Head of the Department Principal